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THE SHISSA REFRACTORY CLAY DEPOSIT

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The Shissa deposit of refractory clays is located on Shissa Mountain, 8 kilometers south of the Cossack village of Zelenchukskaya in Stavropol'Kray. The clays there lie in two beds among quartziferous and micaceous sandstones of the Callovian Age.

The lower bed consists of soft white clay with a slightly greenish tint and sectors of pink clay. It is up to 1.5 meters thick. The upper bed, 8 meters above the lower, consists of fine-grained brown clay, containing dispersed organic matter, streaks of a sooty substance, and fragments of carbonizing wood. This bed is up to 4 meters thick. Other impurities occurring in it here and there are quartz, mica, iron oxides, and accessory minerals as zircon, rutile, garnet, sphene, epidote, zoisite, and others. The melting point of the clays does not fall below 1,650 degrees centigrade.

Particles of less than 0.002-millimeter diameter were used for mineralogical tests of the white and pink lower-bed clays and brown upper-bed clay. Heat, chemical, and microscopic tests were carried out.

The heating curves obtained were similar in all three cases. The thermogram of white clay contains endothermic peaks at 130 and 580 degrees and an exothermic peak at 980 degrees. This is a typical reaction for halloysite. Corresponding peaks for pink clay were 140, 590, and 970 degrees and for brown clay, 130, 570, and over 900 degrees. An additional exothermic peak at about 740 degrees for brown clay is related to its organic matter content.

The chemical composition of the three varieties of clay is as follows:

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	White Clay			Pink Clay			Brown Clay		
	Per-Cent	Molecular Quantity	Molecular Ratio	Per-Cent	Molecular Quantity	Molecular Ratio	Per Cent	Molecular Quantity	Molecular Ratio
SiO_2	46.57	0.776	2.18	46.15	0.769	2.20	46.81	0.779	2.26
Al_2O_3	36.30	0.355	1.00	36.07	0.351	1.00	35.40	0.345	1.00
Fe_2O_3	1.75	0.011	0.03	2.49	0.016	0.04	2.93	0.018	0.52
MgO	0.34	0.007	0.02	0.56	0.015	0.04	0.62	0.015	0.04
CaO	Traces	-	-	-	-	-	Traces	-	-
Na_2O	Traces	-	-	Traces	-	-	Traces	-	-
K_2O	Traces	-	-	Traces	-	-	Traces	-	-
SO_3	-	-	-	-	-	-	Traces	-	-
H_2O	11.14	0.610	1.72 } 2.3	10.08	0.565	1.70 } 2.4	12.63	0.673	1.95 } 2.7
H_2O	3.77	0.210	0.59	4.26	0.239	0.68	4.67	0.259	0.75
Total	100.07			99.61	-	-	103.06	-	-

The table shows that chemically the three varieties are generally similar. However, they differ from the halloysite of other Soviet deposits, Aydyrly, Zaglik, and Kempersay, in respect to greater iron and silica content. This difference is explained by the presence of admixtures of free iron and silicon oxides. The magnesium content in all three cases does not exceed the standards for halloysite and, apparently, isomorphically replaces the alumina in the crystalline structure of halloysite. Disregarding the presence of free iron and silicon oxides in the tested particles, formulas for the minerals approximate the following conditions:

White clay $Al_2O_3 \cdot 2SiO_2 \cdot 2.3\ H_2O$

Pink clay $Al_2O_3 \cdot 2SiO_2 \cdot 2.4\ H_2O$

Brown clay $Al_2O_3 \cdot 2SiO_2 \cdot 2.7\ H_2O$

In respect to water content, these formulas for the minerals occupy an intermediate position between the theoretical formula for halloysite, $Al_2O_3 \cdot 2SiO_2 \cdot 4H_2O$, and the formula for metahalloysite, $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$. It is known that at a temperature above 50 degrees, halloysite partially dehydrates in the direction of metahalloysite. The low water content in the formulas advanced above can be explained by this property of halloysite.

Tested under the microscope, the minerals displayed a fine lamellar structure and an index of refraction N_m of from 1.546 to 1.549. This index of refraction is lower than that of metahalloysite and higher than that of halloysite, a circumstance which agrees fully with the demonstrated chemical composition of the minerals.

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